

R009-P18

ポスター 2 : 9/25 AM1/AM2 (9:00-12:30)

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Numerical modeling of mesoscale dynamics around enormous mountains on Mars

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The Tharsis Montes on Mars is a vast volcanic plateau, boasting four enormous volcanoes, named Ascraeus Mons, Pavonis Mons, Arsia Mons, and Olympus Mons. On the western flank of Arsia Mons, an elongated, luminous cloud of water ice extending over 1500 kilometers was observed by Mars Express orbiter using its Visual Monitoring Camera (VMC). This spectacular weather event underscores the complexity of the atmospheric circulation in this region, where mesoscale phenomena induced by the massive mountainous terrain are thought to be key contributors.

As exploratory research, we started by revisiting observations and numerical simulations of these mesoscale phenomena in the Tharsis Montes region, as documented in prior studies. This review allows us to succinctly outline the characteristic atmospheric circulation in this area. Following this, we utilized numerical simulations to predict the role of these enormous mountains in influencing atmospheric circulation from an idealized experimental perspective. Next, we delve into simulating with real topography. The insights gleaned from this approach will not only advance our understanding of Mars's atmospheric dynamics but also offer valuable context for future explorations of this region.